STREAMTEAM Program Introduction

Soft light filtering through leaves, birds chirping, water gurgling, fish rising . . . Quietly flowing through your neighborhood is one of the many creeks that defines the topography of the Boulder Creek Watershed. A watershed is an area of land where water drains to a stream, river, lake or ocean. The Boulder Creek Watershed extends from the Continental Divide to where Boulder Creek converges with the St. Vrain River east of the county line. It is home to a rich diversity of animal and plant species.

The quality of water directly affects the quality of our lives. We depend on clean water for drinking, recreation, aesthetics, wildlife, irrigation and industry. Each person, through responsible action, has the potential to influence in small yet significant ways the water quality of our streams in the Boulder Creek Watershed.

Purpose

The Streamteam program is designed to be used by people who are interested in learning more about their streams and wetlands.

The objectives of Streamteam are to:

- Encourage citizen commitment to protecting streams.
- Educate people about their relationship to streams and watersheds.
- Facilitate volunteer efforts to enhance local waterways.
- Protect water resources through pollution prevention and water conservation.

Who's in charge?

You are. This is a citizen-driven program. Streamteam is intended to be a long-term stream monitoring program, which is organized and supported by the city of Boulder Stormwater Quality Office.

Interested neighborhoods can form a Streamteam by contacting the Stormwater Quality Office. Streamteam members are asked to complete an application outlining the actions they wish to take to protect and enhance their local waterway. In turn, the city will provide each Streamteam with the necessary equipment, information, and hands-on training workshops to effectively monitor local waterways.

To initiate a Streamteam:

- Contact the Stormwater Quality Office for an application.
- Find friends and neighbors to participate in your Streamteam.
- Choose a waterway for your Streamteam activities.
- Obtain a USGS topographic (topo) map of your area. This map will help you identify the drainage basin for your creek. Topo maps are available at local outdoor stores.
- Finally, develop an action plan with your Streamteam.

Streamteam actions:

- ✓ Participate in monthly or quarterly creek cleanups.
- ✓ Stencil the storm drain in your neighborhood with message:
  DISPOSE NO WASTE. DRAINS TO CREEK
- ✓ Remove non-native plants.
- ✓ Organize neighborhood water quality workshops.
- ✓ Conduct water quality monitoring of stream chemistry or aquatic insect surveys.
- ✓ Report spills or other problems.

Some Creek Work Reminders

- ~ Get permission from landowners if your creek flows through private property. Do not enter areas without permission. It is recommended that you use public access points when possible.
- ~ Always work with a team of two or more.
- ~ Do not put yourself in danger when working in or around the creek.
- ~ Be careful of ticks, poison ivy and insects. It is recommended that you bring repellent and sunscreen, use work gloves and wear good shoes.
- ~ Watch out for unstable banks--your footsteps could speed erosion.
- ~ Be alert for fish and amphibian habitats and, when possible, do not disturb fragile vegetation or wildlife. Remember: it is okay to observe, but refrain from taking animals or plants from their natural environment.
- ~ Use caution around creeks in the spring when they are running high and swift with snowmelt.
- ~ If for any reason you feel uncomfortable about creek conditions or surroundings, please plan your Streamteam activities for another day. Your safety is more important than any of the objectives of the Streamteam program.

For more information or to receive a Streamteam application, please contact:

City of Boulder
Public Works/ Utilities
Stormwater Quality Office
4049 N. 75th Street
Boulder, Colorado 80301
(303) 413-7365

Boulder Creek Watershed Initiative
Jeff Writer, President
607 North Street
Boulder, CO 80304
(303) 245-8486

STREAMTEAM Acknowledgment of Risk and Release

Please read this form carefully and be aware that in participating in STREAMTEAM activities you will be waiving and releasing all claims for injuries you or your child/ward might sustain due to participation in this program

The STREAMTEAM program is organized by the City of Boulder Stormwater Quality Program. Participants will be briefed on the explicit Streamteam duties at periodic orientations. Generally, those participating in a creek clean-up, water quality testing or streambank restoration will come in contact with a variety of potential risks. This list is by no means complete or exclusive, but includes:

1. Physical injuries related to creek clean-up, water quality testing or streambank restoration: twisted ankle, back or neck muscle strain, being cut by glass, falling into the creek, tripping on branches or tree roots;

2. Types of refuse one may come in contact with: paper trash (newspaper, office paper, paper bags); food/beverage containers (glass, aluminum, cardboard); discarded clothing;

3. The stream corridors are used by many people: please be aware that you may come into contact with items that may be contaminated and should be picked up with a trowel and only when wearing heavy-duty gloves: condoms, needles, eating utensils, animal waste, other questionable items.

It is pertinent that each participant in the clean-up and restoration activities have both heavy-duty work gloves and thick-soled work/hiking shoes or boots.

As participant or parent/guardian of a participant in the program, I recognize and acknowledge that there are certain risks of physical injury and I agree to assume the full risk of any injuries, property damage or loss which I or my minor child/ward may sustain as a result of participating in any and all activities connected with or associated with the STREAMTEAM program.

I agree to waive and relinquish all claims I or my minor child/ward may have as a result of participating in the program against the City of Boulder and its officers, agents, servants, and employees.

I further agree to indemnify and hold harmless and defend the City of Boulder and its officers, agents, servants, and employees from any and all claims by other parties resulting from injuries, damages, and losses caused by me or my minor child arising out of, connected with, or in any way associated with the STREAMTEAM Program.

In the event of any emergency, I authorize City officials to secure from any licensed hospital, physician and/or medical personnel any treatment deemed necessary for me or my minor child's immediate care and agree that I will be responsible for payment of any and all medical services rendered.

I have read and fully understand the above program details, waiver and release of all claims and permission to secure treatment and shall not be modified orally.

Participant/Child/Ward Name _____
(please print)

Birth Date _____ Age _____ Sex: M ___ F___

Address _____ Phone _____

Participant/Parent/Guardian Signature _____

Section 1.

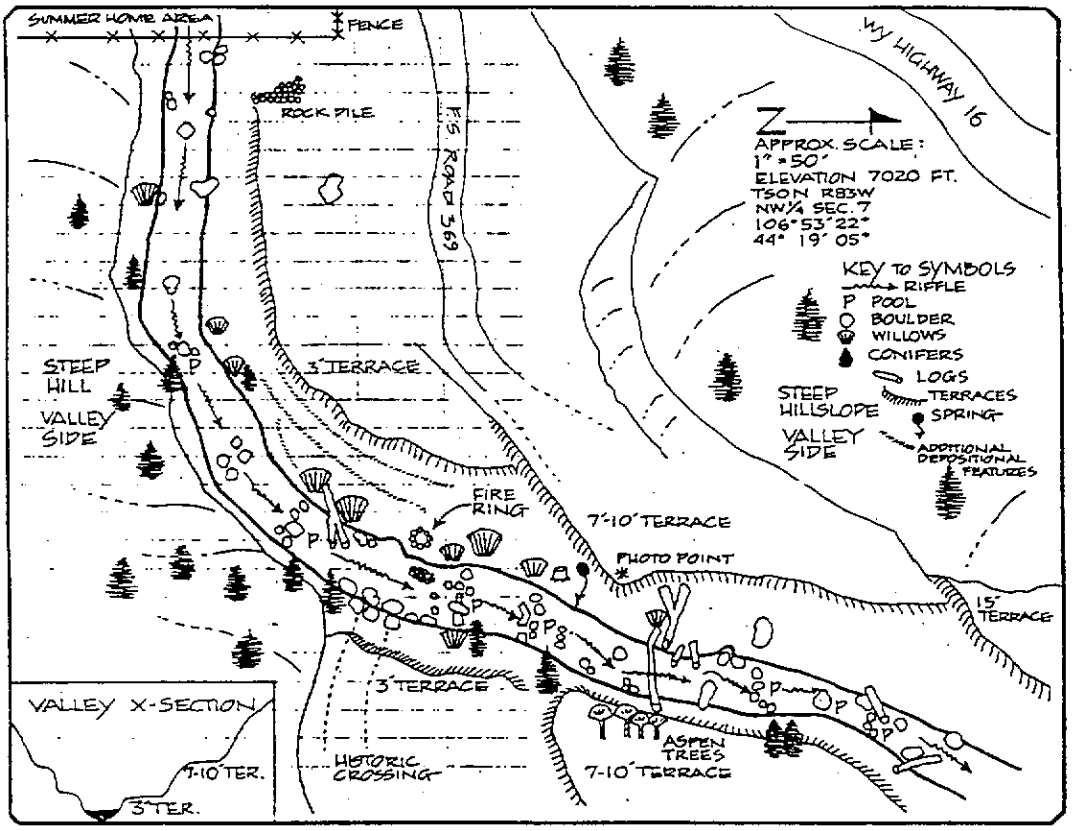
Visual/Notable Assessment of Your Stream

1.0 Riparian Habitat Assessment

The purpose of this assessment is to help neighborhood Stream Team groups gather information about local streams, rivers, and ponds. This information can be used to:

1. quantify environmental impact and evaluate watershed health
2. assess stream response to watershed management
3. allow valid comparisons between different streams
4. establish a record of stream conditions over time

Specific guidelines are described to assist in the establishment of reference sites on your local waterbody. Additionally, specific activities are provided to maintain or improve the health of your local waterbody.



1.1 Development of a site map

Each Stream Team will be provided with a general location map from the City of Boulder Public Works Department.

[1] ***Stream Site ID #*** - Locate your stream on this map and obtain a site number from the City of Boulder.

In addition to using this map it is important to generate your own site map. Draw the site map in the field notebook from direct observation. Use the map drawn on the previous page as an example. Each map should have:

- Stream Name
- Date
- Surveyor Names
- Direction of Stream Flow
- North Arrow
- Map Scale
- Landmarks
- Legend to Symbols
- Valley cross-section
- Pool-riffle sequences
- Gravel and sand bars
- Cross-section

1.2 Physical Characterization

[2] ***Photograph #(s) and Description*** - Make sure to list the date/time of photo, the direction (north etc.) in which the photograph was taken, and any other pertinent information.

[3] ***Predominant Surrounding Area.*** The predominant land use in the area is used to help define how much water can be expected to runoff during storm events, and to target potential non-point pollution sources. (see page 49 - StreamKeepers Field Guide)

[4] ***Local Watershed Erosion*** - Look for the following land-use practices that might effect the amount of erosion that is going on in the watershed:

- recent construction - disturbed soils
- plowed soils
- lack of vegetation
- eroded trails

[5] ***Local watershed non-point source pollution*** - Non-point source pollution is pollution from more than one source. Non-point pollution is difficult to deal with because it is the cumulative

effect of a large number of small sources. Examples of non-point source pollution are pesticide/fertilizer runoff from commercial, agricultural, and residential areas; atmospheric deposition of air pollutants; septic systems; storm drains (see page 13 in the StreamKeepers Handbook).

[6] ***Length of Reach*** - Pick a length of stream based on the table below. You may adopt more than this specified reach, but you should consistently monitor your selected reach for comparative purposes over time.

600'-1200'	- open space
400'	- low/medium density residential/commercial
200'	-high density residential/commercial

[7] ***Estimated Stream Width (ft)*** - measure perpendicular to the predominant flow of water. If stream width is extremely variable, pick locations generally indicative of stream width in your reach.

[8] ***Estimated Stream Depth (ft)*** - If stream depth is extremely variable, pick locations generally indicative of stream depth in your reach.

[9] ***High water mark*** - Look for signs of debris, scoured grass, etc. Measure or estimate from the base of the stream bottom for the vertical measurement. Measure horizontally from the water's edge for the horizontal measurement.

[10] ***Velocity (ft/s)*** - Within your site, measure the distance between two points (one upstream, one downstream). They should be around 50 feet reach with consistent flow (no drops, diversion dams, etc.). Toss your float (a stick, a ball, etc.) into the channel above the upstream point. Start timing when the float crosses the upstream point. Time how long it takes to get to the downstream point. Repeat two times!! See appendix __ for worksheets on completing this task.

[11] ***Stream Discharge (ft^3/s)*** - Stream discharge measures the volume of water flowing in your stream per unit time. See appendix __ for worksheets on completing this task.

[12] ***Dam Present*** - dams include diversion structures, storm flow retention ponds, etc.

[13] ***Channeled*** - Has stream been engineered with concrete riprap, fill, etc.? Has stream been straightened?

1.3 Substrate Components

The composition of the stream bed (substrate) is an important factor in how streams behave. Performing a basic pebble count helps to better understand hydraulics, erosion rates in the watershed, and fish/aquatic insect habitat. The larger the stones, generally the more diverse the habitat. Sand supports minimal fauna, silty sand is somewhat better, and a muddy substrate is slightly better still. A small amount of sand or silt shifting in and around the gravel eliminates

much of the area as suitable habitat for the attachment and hiding of aquatic insects (macroinvertebrates). The amount of gravel/cobble surrounded by fine sediment is termed the embeddness.

[14] ***Sediment odors*** - best estimate hypothesis

[15] ***Sediment Oils*** - look for sheens

[16] ***Sediment Deposits*** - use best estimate

[17] ***Inorganic Substrate*** - Pebble Count Procedure

1. Select a section that is characteristic of your steam that your are monitoring.
2. Using a stick or your hand, avert your gaze and randomly pick up the first particle touched by the tip of your index finger.
3. Measure the intermediate axis (neither the longest nor the shortest)
4. Using the same procedure measure a minimum of 100 particles to obtain a valid count and use a tally sheet.

[18] ***Organic substrate component*** - use best estimate

Habitat Assessment Field Data Sheet (page 2)

Stream _____ **Date** _____

Sample Site ID # _____ **Surveyors** _____

(Adapted from Barbour and Stribling, Visual-Based Habitat Assessment)

Habitat Parameter	**Category**			
	Optimal	Suboptimal	Marginal	Poor
1. Instream Cover Score	Greater than 50% mix of snags, submerged logs, undercut banks, or other stable habitat	30-50% mix of stable habitat; adequate habitat for maintenance of populations	10-30% mix of stable habitat availability less than desirable	Less than 10% mix of stable habitat; lack of habitat is obvious
	12 11 10	9 8 7	6 5 4	3 2 1
2. Epifaunal Substrate Score	Well developed riffle and run; riffle is as wide as stream and length extends two times the width of stream; abundance of cobble	Riffle is as wide as stream but length is less than two times width; abundance of cobble; boulders and gravel common	Run area may be lacking; rifle not as wide as steam and its length is less than 2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present	Riffles or runs virtually nonexistent; large boulders and bedrock prevalent; cobble lacking.
	12 11 10	9 8 7	6 5 4	3 2 1
3. Embeddedness Score	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment
	12 11 10	9 8 7	6 5 4	3 2 1
4. Channel Alteration Score	Channelization or dredging absent or minimal; stream with normal, sinuous pattern	Some channelization present, usually in areas of bridge abutments; evidence of past channelization but recent channelization is not present	New embankments present on both banks; 40-80% of stream reach channelized and disrupted	Banks shored with riprap or cement; over 80% of the stream reach is channelized and disrupted.
	12 11 10	9 8 7	6 5 4	3 2 1
5. Sediment Deposition Score	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material; increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition
	12 11 10	9 8 7	6 5 4	3 2 1

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
6. Frequency of Riffles **Score** ____	occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water of shallow riffles; distance between riffles divide by the width of the stream is > 25.
	12 11 10	9 8 7	6 5 4	3 2 1
7. Channeled Flow Status **Score** ____	Water reaches base of both lower banks and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or < 25% of channel is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	12 11 10	9 8 7	6 5 4	3 2 1
8. Bank vegetative Protection (score each bank) **Note: determine left or right side by facing downstream** **Score LB** _____ **Score RB** _____	More than 90% of the streambank surfaces covered by native vegetation, including trees, understory shrubs, or nonwoody plants; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well represented, disruption evident but not affecting full plant growth potential; more than one-half of the potential plant stubble height remaining.	50-75% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank evident; vegetation has been removed to 2 inches or less in average stubble height.
	12 11 10	9 8 7	6 5 4	3 2 1
	12 11 10	9 8 7	6 5 4	3 2 1
9. Bank Stability (score each bank) **Score LB** _____ **Score RB** _____	Banks stable; no evidence of erosion or bank failure; little potential for future problems	/moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; up to 60% of banks in reach have areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; obvious bank sloughing; 60-100% of bank has erosional scars.
	12 11 10	9 8 7	6 5 4	3 2 1
	12 11 10	9 8 7	6 5 4	3 2 1
10. Riparian Vegetative Zone (score each bank riparian zone) **Score LB** _____ **Score RB** _____	Width of riparian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clearcuts, lawns, or crops have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 8-12 meters; humans activities have impacted zone a great deal.	Width of riparian zone < 6 meters; little or no riparian vegetation due to human activities.
	12 11 10	9 8 7	6 5 4	3 2 1
	12 11 10	9 8 7	6 5 4	3 2 1

Total Score _____

HABITAT ASSESSMENT FIELD DATA SHEET

DATE: _____ TIME: _____ SAMPLER: _____ _____

SAMPLE SITE ID = [1]: _____ PHOTOGRAPH # and DESCRIPTION[2]: _____

REACH DESCRIPTION: _____

_____

COMMENTS: _____

WEATHER CONDITIONS: Sunny Cloudy Partly Cloudy Rain Snow

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE / INSTREAM FEATURES

Predominant Surrounding Land Use [3]:
Forest Field/Pasture Agricultural Residential Commercial Industrial Other _____

Local Watershed Erosion[4]: None Moderate Heavy

Local Watershed NPS Pollution[5]: No evidence Some Potential Sources Obvious Sources
Describe: _____

Length of Reach[6]: _____Ft

Estimated Stream Width[7]: Beginning of Reach _____Ft - Middle of Reach _____Ft - End of Reach Ft

Estimated Stream Depth[8]: Riffle _____Ft Run _____Ft Pool _____Ft

High Water Mark[9]: Horizontal_____Ft Vertical _____Ft

Velocity[10]: _____Ft **Discharge[11]** _____**Ft³/s** **Dam Present[12]:** Yes / No **Channeled[13]:** Yes No

SEDIMENT/SUBSTRATE

Sediment Odors[14]: Normal Sewage Petroleum Chemical Anaerobic None Other _____

Sediment Oils[15]: Absent Slight Moderate Profuse

Sediment Deposits[16]: Sludge Sawdust Paper Fiber Sand Relict Shells Other _____

Are the underside of stones which are not deeply embedded black? Yes / No

Inorganic Substrate Components[17]

Substrate Type	Diameter	% Composition in Sampling Area
Bedrock		
Boulder	> 256mm (10")	_____
Cobble	64-256mm (2.5-10")	_____
Gravel	2-64mm (0.1-2.5")	_____
Sand	0.06-2.00mm (gritty)	_____
Silt	.004-.06mm	_____
Clay	<.004mm (slick)	_____

Organic Substrate Components[18]

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Material	_____
Muck-Mud	Black, Very Fine Organic	_____

WATER QUALITY

Water Temperature _____C **D.O.** _____ mg/l **pH** _____ su **NO_3** _____ mg/L PO_4^{3-} ___ mg/L

Stream Type: Coldwater Warmwater Transition

Water Odors: Normal Sewage Petroleum Chemical None Other _____

Water Surface Oils: Slick Sheen Globe Flecks None

Turbidity: Clear Slightly Turbid Turbid Opaque Water Color _____

STREAM VELOCITY DATA SHEET

Station Name _____ Date of survey ___/___/___

River_____ School_____

1. Starting point description: _____
2. Ending point description: _____
3. Distance in between _____ feet
4. Seconds for orange to travel:
   - First time _____ seconds
   - Second time _____ seconds
   - Third time _____ seconds
   - Average _____ seconds
5. Distance in between stations
   Average number of seconds equals _____ feet/second

Continue to the Stream Discharge Data Sheet

Comments_____

_____

_____

Data recorded by_____ Date recorded _____

Stream Discharge Data Sheet

Station Name _____ Date of survey ___/___/___

River _____ School _____

1. Width of stream channel: at beginning of segment _____ feet

   at middle of segment _____ feet

   at end of segment _____ feet

2. Depths across channel at:

	Beginning of test section	Middle	End
$\frac{1}{4}$ across	feet	feet	feet
$\frac{1}{2}$ across	feet	feet	feet
$\frac{3}{4}$ across	feet	feet	feet

Average depth _____ feet

3. Stream bottom type:
   ☐ rough, loose rocks, coarse gravel or ☐ smooth, mud, sand, hardpan rock

4. Based on the above information, use the following formula to calculate discharge:

$$r = \frac{w\ d\ a\ l}{t}$$

r = rate of flow in cubic feet per second.

w = average width of channel section tested (average of three measurements above).

d = average depth in feet (use average from nine measurements, three of the depth across in three different places, above.

l = length in feet of channel section tested.

t = average time (three tests) in seconds required for float to travel length. (Use number from Stream Velocity Data Sheet.)

a = constant whose value depends on the nature of the stream bottom:
rough, loose rocks, coarse gravel = 0.8
smooth, mud, sand, hardpan bedrock = 0.9

5. Discharge equals rate of flow in cubic feet per second _____ $feet^3$/second

Data recorded by _____ Date recorded _____

Section 2.

Water Quality

Temperature—The "why"

What:

Temperature is the warmness or coldness of water

Why:

1. Affects what organisms can live in water (chart 6). Different life stages might have different temperature requirements as well (chart 7).

Chart 6:

Temperature	Examples of Life
Greater than 68° F, 20° C	Much plant life, many warm water fish diseases. Most bass, crappie bluegill, carp and catfish.
Upper range (55-68° F) (13-20° C) Less than 68° F or 20° C (Cold water)	Some plant life, some fish diseases. Salmon, trout. Stonefly nymphs, mayfly nymphs, caddisfly larvae, water beetles and water striders.
Lower range (Less than 55° F)	Trout, caddisfly larvae, stonefly nymphs and mayfly nymphs.

Chart 7: River Parameter Temperature Values for Brown Trout Life Cycle

		Egg	Fry	Juvenile	Adult
Temperature	Tolerant	0-15	5-25.5	0-27	0-27
(° C)	Optimal	2-13	7-15	7-19	12-19

2. The ability of water to hold oxygen or the solubility of O_2.

3. Metabolism of aquatic life

How:

1. Thermometer measures a change in temperature
2. Varies seasonally and diurnally

Influences:

1. Summer urban runoff
2. Industry
3. Cutting down trees
4. Soil erosion

Dissolved Oxygen—The "why"

What:

Dissolved oxygen is the amount of oxygen (O_2) in air that is in equilibrium with water. When O_2 is in water it is in a dissolved form.

Why:

Dissolved oxygen concentrations affect what can live in water. The necessary amount of dissolved oxygen varies with species, age and activity. (chart 8)

Chart 8: Dissolved O_2 Values for Brown Trout Life Cycle

		Egg	Fry	Juvenile	Adult
O_2	Tolerant	3-25	3-25	3-25	3-25
O_2	Optimal	9-12	9-12	9-12	9-12

How:

1. Varies seasonally and diurnally.

2. The Hach kit is a modified Winkler titration or the Standard Winkler oxidation reduction titration.

How is it measured?

The Winkler method indirectly measures dissolved oxygen by taking advantage of how iodine reads with an acid. You added manganus sulfate and akali iodide to "fix" the sample. Then you added sulfuric acid to complet the "fix."

In the presence of base (OH^-),—which is in water—dissolved oxygen reacts with manganous ion (Mn^{+2}) to form manganese dioxide (equation 1). When you add acid (H+ or sulfamic acid), the manganese dioxide will react with iodide to form iodine (equation $_{2+3}$). The amount of iodine formed is exactly twice the amount of dissolved oxygen originally present in the water. So if you know the amount of iodine, you can determine the amount of dissolved oxygen originally present. The

amount of iodine can be determined by titration with solium thiosulfate ($N_2S_2O_3$-) (equation 4). Starch is used as the final indicator to assist making the endpoint more consistent and reliable to see.. Starch turns blue if iodine is present but turns colorless after all the iodine is reacted with the sodimthiosulfate.

The Hach kit modifies this Winkler titration by using less sample (60 mls vs 300 mls), not using starch as a final indicator and does not use a class "A" buret to titrate (uses unmarked cylinder).

Chemical reactions:

1. $Mn^{+2} + 2OH^- + O_2 \rightarrow MnO_2 + H_2O$

2. $MnO_2 + 2I^- + 4H^+ \rightarrow Mn^{+2} + I_2 + H_2O$

3. $I_2 + I^- \rightarrow I_3^-$

4. $I_3^- + 2S_2O_3^{-2} \rightarrow S_4O_6^{-2} + 3I^-$

For simplicity, you may want to combine reactions

$$I_2 + 2S_2O_3^{-2} \rightarrow S_4O_6^{-2} + 2I^-$$

Influence:

1. Varies with temperature, See Table 1, page 85., atmospheric pressure (elevation). See Table 2, page 86 for velocity.

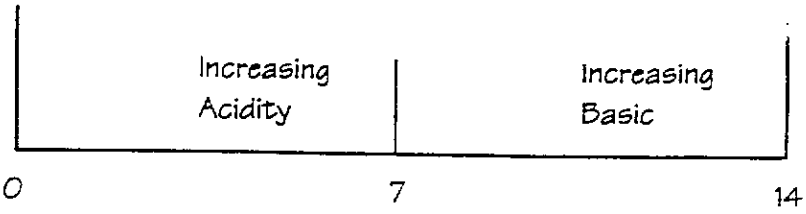
2. Organic wastes from waste water treatment, industry and runoff. Bacteria consume O_2 while decomposing organic material.

pH—The "why"

Consider that deionized water, $H_2O = H^+ + OH^-$

What:

1. pH ranges from 0-14, pH is the measure of the hydrogen ion (H^+) concentration. The OH^- is a hydroxyl ion.



When pH increases in acidity, more H^+ is present than OH^-.When pH increases in base, more OH^- is present than H^+s. Which of these conditions are better?

2. We call charged (+) or (-) particles ions. For instance, H^+ or OH^- is an ion. As implied by the name, deionized water contains zero ions, or has equal amounts of OH^- and H^+. It has a pH of seven (7). Acidic water has more H^+s than OH^-s and, therefore, has a pH value that is less than seven (0-7). Basic water has more OH^-s than H^+s and, therefore, has a pH value greater than seven (7-14).

Chart 1:

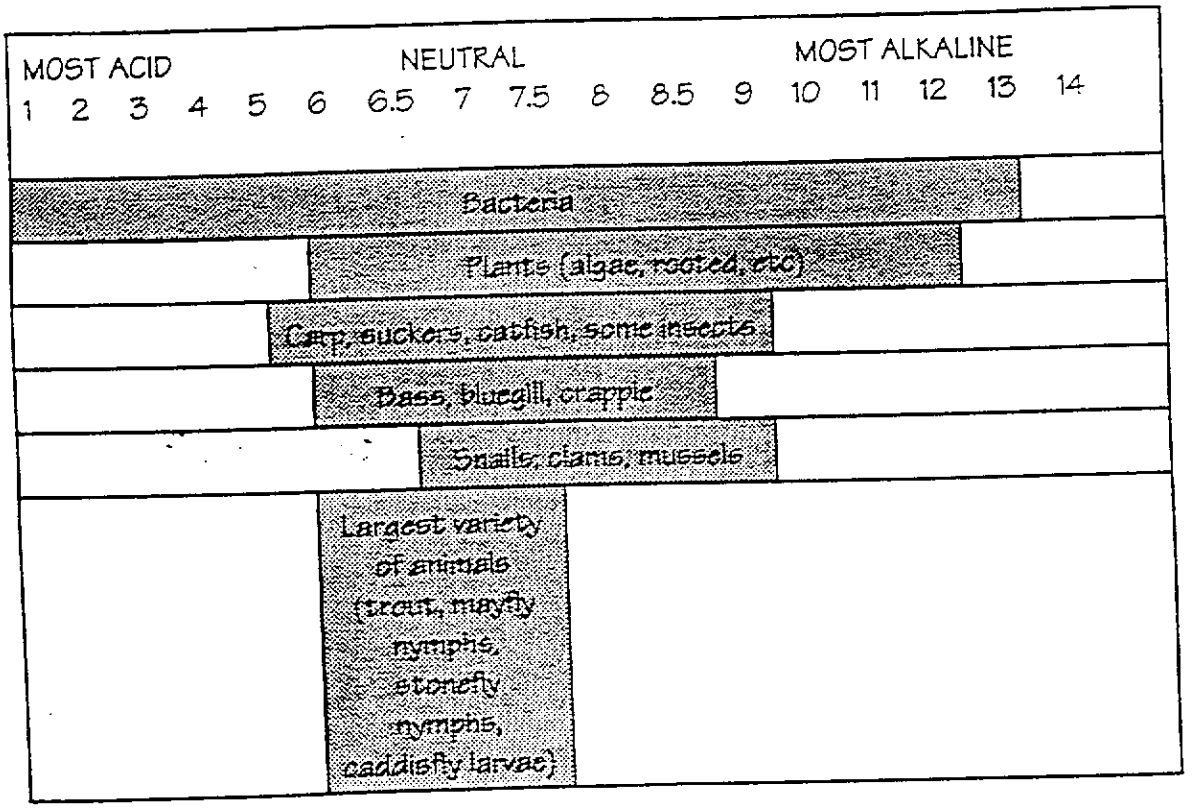
3. Natural water is usually between 6.5 and 9.5. (chart 1)

4. pH is a logarithmic scale. For example, the difference between a pH of 5-6 is 10; between 5-7 is 100; between 5-8 is 1,000.

Why:

1 pH affects what can live in water by influencing the bloods' ability to hold oxygen. (chart 2)

Chart 2: pH scale.



2. pH can affect a certain life stage of an organism. (chart 3)

Chart 3: River Parameter pH Values for Brown Trout Life Cycle.

		Egg	Fry	Juvenile	Adult
pH	Tolerant	5.0-9.5	5.0-9.5	5.0-9.5	5.0-9.5
pH	Optimal	6.8-7.8	6.8-7.8	6.8-7.8	6.8-7.8

3. pH can influence the state of metals in water and buffering capacity (alkalinity) of water. For example: At a pH of 3, Iron is Fe^{2+} but at a pH of 7 it changes to Fe^{3+}.

How:

1. Litmus paper, pH pen or pH meter.
2. Fluctuates seasonally and diurnally.

Influences:

1. Acid rain from car and coal plant emissions.
2. Acid mine drainages.

Section 3.

Macro Invertebrate Sampling

People to Contact

Reference Appendix

People, Places, Books, Articles , Web Sites and More

City of Boulder

City Water Hotline	413-4H2O
Tammi Laninga, Water Resource Educator	413-7365
Paul Lander, Water Conservation Office	413-7407
Brad Segal, Drinking Water Program	413-7400
Water Quality General Number	413-7350

Boulder Creek Watershed Initiative

Jeff Writer, President	245-8486
Mark McCaffery, Board Member	449-3955
Larry Barber, USGS and Board Member	541-3039
Jim Disinger, BCWI Member	440-8022

Books/Articles*

Harrelson, Cheryl; etal. *Stream Channel Reference Sites: An Illustrated Guide to Field Techniques.* U.S. Department of Agriculture - Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. Report RM-245.

Jacobson, Cliff. *Water, Water Everywhere: Water Quality Factors Reference Unit.* Hach Company. Loveland, CO. 1991.

Mitchell, Mark and William Stapp. *Field Manual for Water Quality Monitoring.* Thomas-Shore, Inc. Dexter, MI. 1992.

Hach Company. *Water Analysis Handbook.* 2nd ed. Loveland, CO 1992.

Wolfe, Mary Ellen. *A Landowner's Guide to Western Water Rights.* Roberts Rinehart Publ. Boulder, CO. 1996.

*** Please see Attached Resource Lists of Books, Videos, and Films for Kids, Families and Adults.**

Web Pages*

Boulder Creek Watershed Web Page http://csf.colorado.edu/bcwatershed

*** For Additional Web Page Addresses, please see Attached List.**

References

Water Resources Books, Videos and Films
For Kids and Families

ENGLISH BOOK TITLES

E1. Bellamy, David, 1988. **Our Changing World, The River**. New York: Clarkson N. Potter,Inc., pp.1-24.

E2. Caduto, Michael, 1990. **Pond and Brook**. Hanover: University Press of New England, pp.iii-276.

E3. Cole, Joanna, 1986. **The Magic School Bus at the Waterworks**. New York: Scholastic Inc., pp.7-39.

E4. Cooper, Ann, Ann Armstrong, & Carol Kampert, 1991. **The Wildwatch Book: Ideas, Activities, and Projects for Exploring the Wildlife of Colorado's Front Range**. Colorado: Roberts Rinehart Publishers, pp.1-96.

E5. Dewey, Jennifer Owings, 1987. **At the Edge of the Pond**. Boston: Little, Brown and Company, pp.1-45.

E6. Doan, Kenneth, Dr., 1987. **Wilderness Album Series, FISH**. Canada: Hyperion Press Limited, pp.2-40.

E7. Housby, Trevor, 1990. **The Concise Illustrated Book of Freshwater Fish**. New York: Gallery Books, pp.6-46.

E8. Jennings, Terry, 1985. **The Young Scientist Investigates Pond Life**. Chicago: Childrens Press, pp.2-34.

E9. Lyons, Janet, & Sandra Jordan, 1989. **Walking the Wetlands**. New York: John Wiley & Sons, pp.vii-222.

E10. Parker, Steve, 1990. **Eyewitness Books, FISH**. New York: Alfred A. Knopf, pp.6-63.

E11. Reid, George, Dr., 1987. **Pond Life**. New York: Golden Press, pp.2-160.

E12. Robertson, Kayo, 1991. **Signs Along the River: Learning to Read the Natural Landscape**. Colorado: Roberts Rinehart Publishers, pp.1-64.

E13. Sabin, Francene, 1982. **Wonders of the Pond**. New Jersey: Troll Associates, pp.3-32.

E14. Schaffner, Herbert, 1989. **Freshwater Game Fish of North America**. New York: Gallery Books, pp.10-144.

E15. Schwartz, David, 1988. **The Hidden Life of the Pond**. New York: Crown Publishers, Inc., pp.1-38.

E16. Thompson, Peter, 1985. **Thompson's Guide to Freshwater Fishes**. Boston: Houghton Mifflin Company, pp.ix-205.

E17. Water Pollution Control Federation, 1990. **Saving Water: The Student's Resource Guide**. Virginia: Public Eduaction Program of WPCF, pp.2-22.

E18. Water Pollution Control Federation, 1988. **Surface Water: The Student's Resource Guide**. Virginia: Public Education Program of WPCF, pp.3-30.

E19. Water Pollution Control Federation, 1987. **Wastewater Treatment: The Student's Resource Guide**. Virginia: Public Education Program of WPCF, pp.6-30.

E20. Wheeler, Alwyne, 1991. **Usborne First Nature, FISHES**. Oklahoma: EDC Publishing, pp.2-24.

E21. Cherry, Lynne, 1992. **A River Ran Wild**. New York: Harcourt Brace Jovanovich, Publishers, pp. 1-26.

E22. Cole, Joanna, 1992. **The Magic School Bus on the Ocean Floor**. New York: Scholastic Inc., pp. 4-41.

E23. Ganeri, Anita, 1992. **And Now... the Weather**. New York: Aladin Books, pp. 2-29.

E24. Taylor, Barbara, 1992. **River Life**. New York: Dorling Kindersley, Inc., pp. 8-29.

E25. Taylor, Kim, 1992. **Water**. New York: John Wiley & Sons, Inc., pp. 4-32.

E26. Butterfield, Moira, 1991. **Frog**. New York: Little Simon, pp. 16.

E27. Goldman Koss, Amy, 1987. **Where Fish Go in Winter**. Los Angeles: Price Stern Sloan, pp. 30.

E28. Locker, Thomas, 1984. **Where the River Begins**. New York: Dial Books, pp. 26.

E29. Moorhead, Carol Ann, 1992. **Colorado's Backyard Wildlife**. Colorado: Roberts Rinehart Publishers, pp. 130.

E30. Schmidt, Gerald D., 1990. **Let's Go Fishing**! Colorado: Roberts Rinehard Publishers, pp. 85.

E31. Seixas, Judith, 1987. **Water: What it is, What it Does**. New York: Greenwillow Books, pp. 55.

E32. Water Pollution Control Federation, 1989. **The Groundwater Adventure**. Public Education Program of WPCF, pp. 30.

E33. Barrett, Norman, 1989. **Rivers and Lakes**. New York: Franklin Watts, pp. 32.

E34. Berry, Joy, 1984. **What To Do When Your Mom or Dad Says... "Turn Off the Water & Lights!"** Grolier Enterprises Corp, pp. 48.

E35. Liptak, Karen, 1991. **Saving Our Wetlands and Their Wildlife.** New York: Franklin Watts, pp. 61.

E36. Thompson-Hoffman, Susan, 1989. **Delver's Danger**. Smithsonian Wild Heritage Collection, pp. 31.

E37. Wheeler, Jill, 1990. **The Water We Drink**. Minnesotta: Abdo & Daughters, pp. 32

E38. Peters, Lisa Westberg, 1991. **Water's Way**. New York: Arcade Publishing, Inc., pp. 28.

E39. Bruchac, Joseph. **Koluscap and the Water Monster; Native American Stories**. Colorado: Fulcrum Publishing, pp. 5.

E40. Kalman, Bobbie and Janine Schaub, 1992. **Wonderful Water**. New York: Crabtree Publishing Company, pp. 31.

SPANISH BOOK TITLES

S1. Jennings, Terry, 1988. **El Joven Investigador, El Agua**. Madrid: Oxford University Press, pp.2-32.

S2. Jennings, Terry, 1990. **El Joven Investigador, Vida acuatica**. Madrid: Oxford University Press, pp.2-32.

S3. George, Jean Craighead, 1983. **La Tierra que Habla**. Madrid: Ediciones Alfaguara, S.A., pp.11-133.

S4. Gil, Fernando Martinez, 1980. **El Rio de los Castores**. Madrid: Editorial Noguer, S. A., pp.11-122.

S5. Vendrell, Carme Sole, & Josep Mo Parramon, 1985. **Senses, Seasons and Elements Series, El Agua**. New York: Barron's, pp.1-26.

VIDEO TITLES

V1. U.S. Fish and Wildlife Services, 1987. **"America's Wetlands"**. Time 25:50.

V2. National Geographic Society, 1987. **"Rocky Mountain Beaver Pond"**. Time 60:00.

V3. Tell Me Why, The Childrens Video Encyclopedia, 1987. **"Fish, Shellfish, and Other Underwater Life"**. Time 30:00.

V4. Time Life Video, 1987. **"The Living Planet, Sweet Fresh Water"**. Time 60:00.

V5. Water Pollution Control Federation, 1987. **"Saving Water: The Conservation Video"**. Time 8:00.

V6. Water Pollution Control Federation, 1987. **"H O TV: The Wastewater Video"**. Time 10:48.

V7. City of Boulder, Channel 8, 1988. **"The Boulder Water Story"**. Time 13:30.

V8. Colorado Wildlife Heritage Foundation, 1992. **"Water Wonders"**. Time 24:30.

V9. 3-2-1 Contact, 1991. **"Down the Drain."** Time 30.

V10. Oregon State Extension Service, 1996. **"We All Live Down Stream."** Time 28:30

FILMSTRIP TITLES

F1. National Geographic Society, 1978. **"Saving Our Planet- Saving Our Land & Saving Our Air and Water"**. Time 14:00 each.

F2. National Geographic Society, 1989. **"A World of Water- Earth's Lifeline & Water, Water, Everywhere?"**. Time 14:00 each.

F3. National Geographic Society, 1985. **"The Water's Edge: Life Along the Great Rivers- The Amazon, The Mississippi & The Nile"**. Time 16-18:00 each.

Water Resources Books for Adults

* 1. Augustyn, Jim, 1979. **The Solar Cat Book**. California: Ten Speed Press, pgs. 96.

2. Brower, David, 1991. **Work in Progress**. Salt Lake City: Peregrine Smith Books, pgs. 321.

3. Buzzelli, Buzz, Peggy Good, Janice McCormick, and John McCormick, 1991. **How to Get Water Smart**. California: Terra Firma Publishing, pgs. 126.

4. Carson, Rachel, 1962. **Silent Spring**. Boston: Houghton Mifflin Company, pgs. 357.

5. The CEIP Fund, 1989. **The Complete Guide to Environmental Careers**. Washington D.C.: Island Press, pgs. 317.

6. Clarke, Robin, 1991. **Water: the International Crisis**. London: Earthscan Publishing LTD, pgs., 193.

7. Dunne, Thomas, and Luna B. Leopold, 1978. **Water in Environmental Planning**. New York: W.H. Freeman and Company, pgs. 815.

* 8. Ellefson, Connie, Tom Stephens, and Doug Welsh, 1992. **Xeriscape Gardening**. New York: Macmillan Publishing Co., pgs., 323.

9. Ernest, Joseph, 1991. **Worthwhile Places: Correspondence of John D. Rockefeller, Jr. and Horace M. Albright**. New York: Fordham University Press, pgs. 347.

10. Evans, Howard E., and Mary A. Evans, 1991. **Cache La Poudre**. Colorado: University Press at Colorado, pgs. 259.

11. Flader, Susan L., and J. Baird Callicott, 1991. **River of the Mother of God and Other Essays by Aldo Leopold**. Wisconsin: The University of Wisconsin Press, pgs. 371.

12. Fradkin, Phillip L., 1981. **River No More**. Arizona: The University of Arizona Press, pgs. 355.

13. Gershon, David, and Robert Gilman, 1992. **Household Ecoteam Workbook**. New York: Global Action Plan for the Earth, pgs.,145.

14. Giono, Jean, 1987. **The Man Who Planted Trees**. Vermont: Chelsea Green Publishing Company, pgs. 52.

15. Gore, Al, 1992. **Earth in Balance**. Boston: Houghton Mifflin Company, pgs. 394.

16. High Country News, 1987. **Western Water Made Simple**. Washington D.C.: Island Press,

pgs. 221.

17. Holbrook, Stewart, 1956. **The Columbia**. Athens, Ohio: Swallow Press/ Ohio University Press, pgs. 327.

18. Hunt. Constance Elizabeth, 1988. **Down by the River**. Washington D.C.: Island Press, pgs. 251.

19. Kittleridge, William, 1992. **Hole in the Sky; A Memoir**. New York: Alfred A. Knopf, Inc., pgs. 238.

20. Kromm, David E., and Stephen E. White, 1992. **Groundwater Exploration in the High Plains**. Kansas: University Press of Kansas, pgs.233.

21. Lawrence, H. Lea, 1992. **Prowling Papa's Waters**. Georgia: Longstreet Press, pgs. 201.

22. Leopold, Aldo, 1949. **A Sand County Almanac**. Oxford University Press, Inc., pgs. 227.

23. Leopold, Luna B., 1991. **Round River: From the Journals of Aldo Leopold**. Northword Press, Inc., pgs. 238.

24. Lopez, Barry, 1988. **Crossing Open Ground**. New York: Vintage Books, pgs. 93.

25. Lopez, Barry, 1976. **Desert Notes and River Notes**. New York: Avon Books, pgs. 133.

26. Mackenzie, Dorothy, 1991. **Design for the Environment**. New York: Rizzoli, pgs. 173.

27. Martin, Russell, 1989. **A Story That Stands Like a Dam**. New York: Henry Holt and Company, pgs. 341.

* 28. Maxwell, Galvin, 1960. **Ring of Bright Water**. Penguin Books, pgs. 212.

29. Meine, Curt, 1988. **Aldo Leopold, His Life and Work**. Wisconsin: The University of Wisconsin Press, pgs. 621.

30. Mills, Enos A., 1990. **In Beaver World**. Lincoln: University of Nebraska, pgs. 231

* 31. Mowat, Farley, 1972. **A Whale for the Killing**. Toronto: Seal Books, pgs. 213.

32. Muir, John, 1992. **John Muir; The Eight Wilderness-Discovery Books**. London: Diadem Books, pgs. 1026.

33. Mutel, C.F., and J.C. Emerick, 1992. **From Grassland to Glacier**. Boulder: Johnson Books, pgs. 287.

34. Obee, Bruce, and Graeme Ellis, 1992. **Guardians of the Whales**. Anchorage: Alaska Northwest Books, pgs. 166.

35. Powell, J.W., 1961. **The Exploration of the Colorado River**. New York: Dover Publications, Inc., pgs. 397.

* 36. Pratt, Joanne Henderson, James Pratt, Sarah Barnett Moore, and William T. Moore, 1979 **Environmental Encounter**. Reverchon Press, pgs. 166.

37. Reisner, Mark, 1986. **Cadillac Desert**. Penguin Books, pgs. 565.

38. Reisner, Mark, and Sarah Bates, 1990. **Overtapped Oasis**. Island Press, pgs. 185.

39. Rinehart, Fredrick R., and Elizabeth A. Webb, 1990. **Close to Home Colorado's Urban Wildlife**. Roberts Rinehart, Inc., pgs. 179.

40. Simmons, Virginia McConnell, 1990. **The Upper Arkansas, A Mountain River Valley**. Boulder: Pruett Publishing Company, pgs. 341.

41. Stegner, Wallace, 1954. **Beyond the Hundredth Meridian**. Penguin Books, pgs. 420.

42. Trotter, Patrick C., 1987. **Cutthroat; Native Trout of the West**. Boulder; Colorado Associated University Press, pgs. 2109.

43. Tweit, Susan H., 1990. **Pieces of Light, A Year on Colorado's Front Range**. Roberts Rinehart, Inc., Publishers, pgs. 248.

44. Wallace, David Rains, 1987. **Life in the Balance**. Harcourt Brace Jovanovich, Publishers, pgs. 301.

45. Waters, Frank, 1946. **The Colorado**. Athens: Swallow Press/Ohio University Press. pgs. 389.

46. Wilkinson, Charles F., 1992. **Crossing the Next Meridian**. Washington. D.C.: Island Press, pgs. 367.

47. Worster, Donald, 1985. **Rivers of Empire**. Oxford: Oxford University Press, pgs. 389

48. Zwinger, Ann, 1975. **Run, River, Run**. The University of Arizona Press, Inc., pgs. 227.

49. Fielder, John and Mark Pearson, 1993. **Colorado, Rivers of the Rockies**. Englewood, CO: Westcliffe Publishers, Inc., pgs. 128.

50. Robinson, Sandra, Dennis Nelson, Susan Higgins, and Michael Brody, 1993. **Water, A Gift of Nature; The Story Behind the Scenery**. Las Vegas, NV: KC Publications, pgs. 48.

* these books are missing.

Attachments

- Volunteer Hours
- Release Forms
- Habitat Assessment Field Data Sheets

STREAMTEAM Volunteer Log-In Sheet

Streamteam Leader: _____

Stream Name: _____

Date	Activity	Number of People	Number of Hours

Call us after you've put in 100 hours!
A sign will be placed on your section of creek, highlighting your hard work!

Questions? Comments?
Call the Water Resource Educator at 413-7365

CITY OF BOULDER PUBLIC WORKS DEPARTMENT

STREAMTEAM Acknowledgment of Risk and Release

Please read this form carefully and be aware that in participating in STREAMTEAM activities you will be waiving and releasing all claims for injuries you or your child/ward might sustain due to participation in this program.

The STREAMTEAM program is organized by the City of Boulder Stormwater Quality Program. Participants will be briefed on the explicit Streamteam duties at periodic orientations. Generally, those participating in a creek clean-up, water quality testing or streambank restoration will come in contact with a variety of potential risks. This list is by no means complete or exclusive, but includes:

1. Physical injuries related to creek clean-up, water quality testing or streambank restoration: twisted ankle, back or neck muscle strain, being cut by glass, falling into the creek, tripping on branches or tree roots;

2. Types of refuse one may come in contact with: paper trash (newspaper, office paper, paper bags); food/beverage containers (glass, aluminum, cardboard); discarded clothing;

3. The stream corridors are used by many people: please be aware that you may come into contact with items that may be contaminated and should be picked up with a trowel and only when wearing heavy-duty gloves: condoms, needles, eating utensils, animal waste, other questionable items.

It is pertinent that each participant in the clean-up and restoration activities have both heavy-duty work gloves and thick-soled work/hiking shoes or boots.

As participant or parent/guardian of a participant in the program, I recognize and acknowledge that there are certain risks of physical injury and I agree to assume the full risk of any injuries, property damage or loss which I or my minor child/ward may sustain as a result of participating in any and all activities connected with or associated with the STREAMTEAM program.

I agree to waive and relinquish all claims I or my minor child/ward may have as a result of participating in the program against the City of Boulder and its officers, agents, servants, and employees.

I further agree to indemnify and hold harmless and defend the City of Boulder and its officers, agents, servants, and employees from any and all claims by other parties resulting from injuries, damages, and losses caused by me or my minor child arising out of, connected with, or in any way associated with the STREAMTEAM Program.

In the event of any emergency, I authorize City officials to secure from any licensed hospital, physician and/or medical personnel any treatment deemed necessary for me or my minor child's immediate care and agree that I will be responsible for payment of any and all medical services rendered.

I have read and fully understand the above program details, waiver and release of all claims and permission to secure treatment and shall not be modified orally.

Participant/Child/Ward Name _____
(please print)

Birth Date _____ Age _____ Sex: M ___ F ___

Address _____ Phone _____

Participant/Parent/Guardian Signature _____